



# Improved building design by joint calculating building costs and environmental costs?

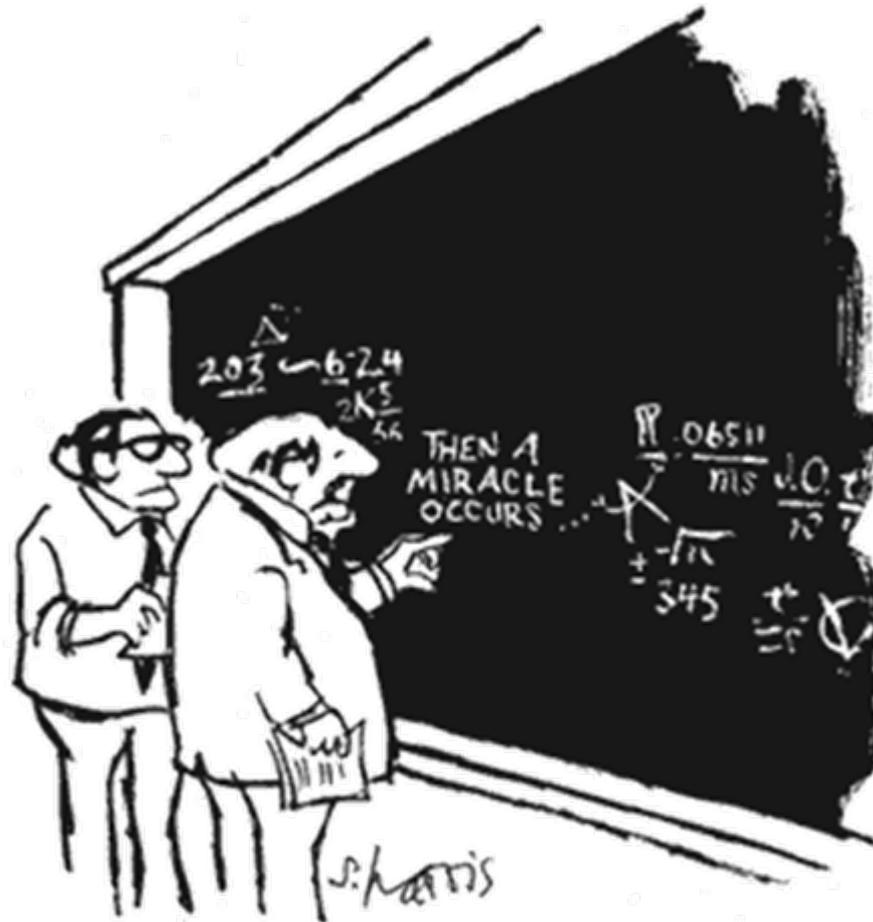
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Photo: Kristin Holthe



# Why document environmental qualities?



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

# Calculating environmental qualities in buildings today – what's the problem?

- Lack of databases with satisfactory environmental input data on materials, building products and elements
  - A lot of data is needed in order to assess environmental qualities in alternative design solutions
  - Require collecting data for design options (generic or specific)
  - Existing data on buildings products are not “available” (only available for manufacturer itself, format not available for import in assessment tools)
- Performance of Life Cycle Assessments (LCA)
  - Assessing environmental qualities taking the whole life cycle of a building into account
  - With poor/insufficient data quality - the result of a LCA significant reduced
  - Practical problems; time needed to perform an LCA, lack of agreed methods for the final assessment steps
  - Tools suited for a specific need? Addressing the right decision maker?
  - Not integrated with existing processes, existing tools

**How may environmentally effective buildings be more competitive?**

**➔ Monetary weighting of environmental effects**

**Improved building design by joint calculation of buildings costs and environmental costs**

# The GLITNE project

”Putting a price on green”

## Who

Snøhetta architects (owner)  
15 industry partners  
SINTEF (project management)

## What

National R&D project 2006-2009  
Funding: The Norwegian  
Research Council



# Main objectives



- Produce a method and a tool to show the environmental consequences of a building, for the user, government and business
- Identify how the partners in the project may use the method in environmental product development and therein innovative solutions
- Suggest a model for extended producer responsibility that will benefit the construction / building industry

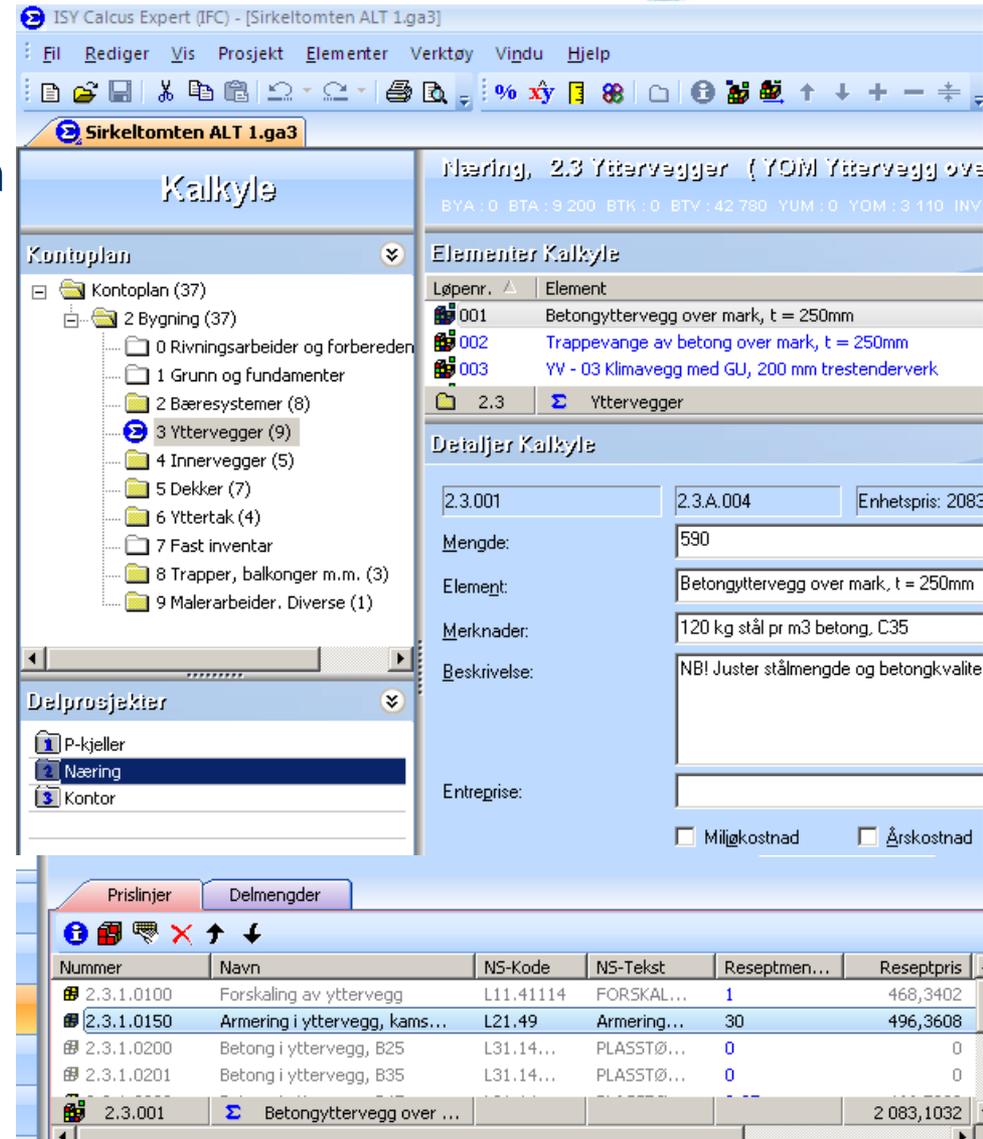


# Criteria for the method and tool

- Survey and input from the industry partners
- Method
  - Monetary based principle for weighting of environmental effects (“put a price on green”)
  - Whole life cycle of the building into account
  - Use LCA-based input data
- Tool
  - Manage to identify the environmental consequence in the early design phase
  - Suited for the needs of the different actors; architect, contractor, consultants etc. and the building process
  - Show environmental effect of different design alternatives
  - Communicate with a BIM open formats (IFC) for interoperability

# Tool Calcus

- Integrate the GLITNE method in an existing tool for calculating building costs
- Typical users: e.g. architects, engineers, contractors, owners
- “Living” building cost model from idea > schematic design > early design > detail design
- Key quantity data from a building element database (1.500 predefined elements)
- 43 predefined model building projects
- Identify drivers for building costs



The screenshot displays the ISY Calcus Expert (IFC) - [Sirkeltomten ALT 1.ga3] interface. The main window is titled 'Kalkyle' and shows a project tree on the left with 'Kontoplan (37)' expanded to '3 Yttervegger (9)'. The right pane shows 'Elementer Kalkyle' with a list of elements including 'Betongyttervegg over mark, t = 250mm' (001), 'Trappevange av betong over mark, t = 250mm' (002), and 'YV - 03 Klimavegg med GU, 200 mm trestenderverk' (003). Below this, the 'Detaljer Kalkyle' section shows details for element 2.3.001, including 'Menge: 590', 'Element: Betongyttervegg over mark, t = 250mm', and 'Enhetspris: 2083'. At the bottom, a table shows a breakdown of costs:

Nummer	Navn	NS-Kode	NS-Tekst	Reseptmen...	Reseptpris
2.3.1.0100	Forskaling av yttervegg	L11.41114	FORSKAL...	1	468,3402
2.3.1.0150	Armering i yttervegg, kams...	L21.49	Armering...	30	496,3608
2.3.1.0200	Betong i yttervegg, B25	L31.14...	PLASSTØ...	0	0
2.3.1.0201	Betong i yttervegg, B35	L31.14...	PLASSTØ...	0	0
2.3.001	Betongyttervegg over ...				2 083,1032

# BIM calculation (IFC format)



## Import of CAD model

- Calcus will recognize name/type number for an automatic match to the elements in Calcus
- Ore: Drag and drop (poorly prepared BIM)

## Beta version (soon to be released)

- GHG emissions (organized the “same way” as building costs)

Lagernr.	Element	Mængde	Enhed	Enhedspris	Sum	IFC Type	IFC Nr
0001	SI\SI\konstruktioner-S\Styler	374,22	m	0,00	0,00	IFCColumn	
0002	Profilerkede elementer-S\SI\Styler	140,32	m	0,00	0,00	IFCColumn	
0003	Belægning-S\Styler	37,15	m	0,00	0,00	IFCColumn	
0004	Belægning-S\Styler	547,88	m	0,00	0,00	IFCColumn	
0005	SI\SI\konstruktioner-S\Styler	1.405,93	m	0,00	0,00	IFCColumn	

Lagernr.	Element	Mængde	Enhed	Enhedspris	Sum
001	IFC	0,00	m	0,00	0,00
002	IFC	0,00	m	0,00	0,00
003	IFC	0,00	m	0,00	0,00
004	IFC	0,00	m	0,00	0,00
005	IFC	0,00	m	0,00	0,00
006	IFC	0,00	m	0,00	0,00
007	IFC	0,00	m	0,00	0,00
008	IFC	0,00	m	0,00	0,00
009	IFC	0,00	m	0,00	0,00
010	IFC	0,00	m	0,00	0,00
011	IFC	0,00	m	0,00	0,00
012	IFC	0,00	m	0,00	0,00
013	IFC	0,00	m	0,00	0,00
014	IFC	0,00	m	0,00	0,00
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100	IFC	0,00	m	0,00	0,00

Pictures based on Norconsult



# Method - environmental costs

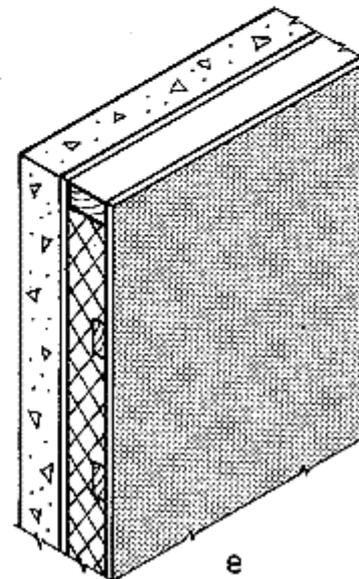
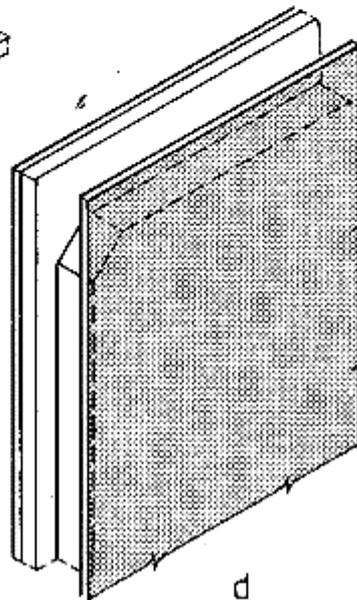
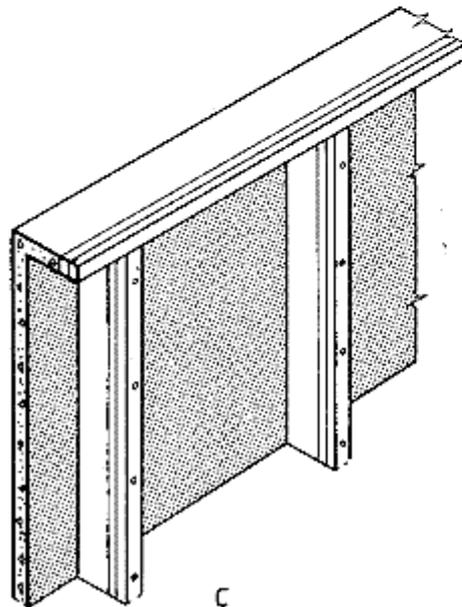
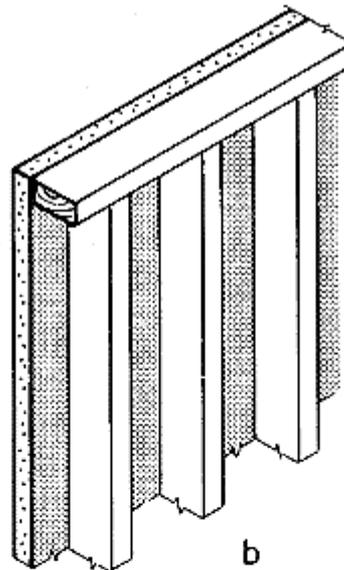
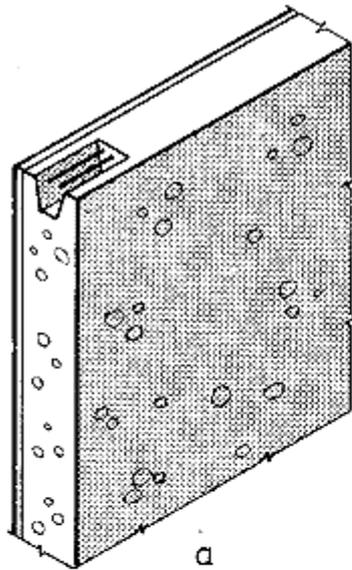
- Three prioritized environmental effects
  1. Climate change (greenhouse gases)
  2. Human and environmental toxicity (e.g. connected to the use of chemicals)
  3. Waste to disposal
- Method established for economic valuation (NOK)
- Goal: to cover whole life cycle of the building
  - Whole life cycle environmental data from (Environ. Product Decl. –EPDs)
  - Energy demand in the building’s operational phase
- Huge challenge: LCA-based environmental input data

# What's in CALCUS

Building costs (NOK) - exists

Environmental costs (NOK)

- ← 1) Climate data/cost – data exists
- 2) Toxicity data/cost – under dev.
- 3) Waste data/cost – under dev.



Environmental data connected to specific cases are collected

Operational energy not included yet

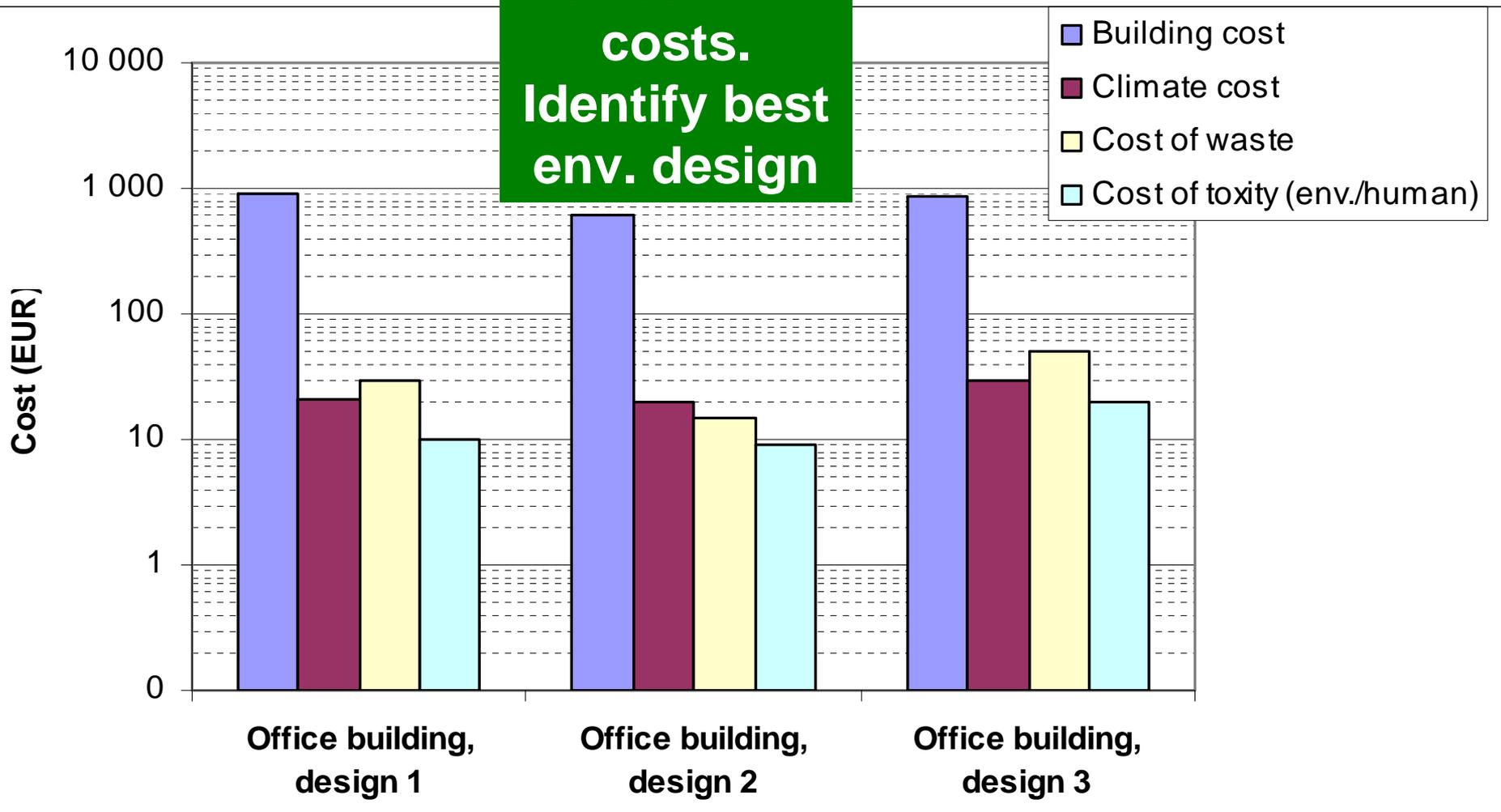


# Cases in GLITNE

- Office no. 1
  - Interior rehabilitation (2005)
  - Completed
- Office no. 2
  - Office area, parking basement
  - Completed (2003)
- Office no. 3
  - Under construction
  - Parking, offices and public shopping areas.
- Different alternatives of the three office buildings where calculated by using predefined elements and model buildings in the Calcus tool



**Lowest total costs.  
Identify best env. design**





# Improved building design?

(So far so good. And plenty of further work...)

- Until now:
  - some data already integrated in CALCUS (building costs, GHG emissions)
  - Integrate actual costs for waste disposal
  - Integrate some data on substances contributing to human and environmental toxicity (connected to cases)
- The ideal – connect EPD databases to CALCUS + GLITNE tool
- Testing of the tool
  - Identify total environmental costs for the cases, different design alt.
  - How will changes in Calcus affect architectural design (CAD tools), energy demand (energy simulation tools) – interoperability, use of BIM
  - Observe “real life use”

# How do this contribute to IDS?

people, process, technology

- Reuse of data (same objects carrying data about building costs, environmental qualities/costs)
- Interoperability (BIM, open formats)
- Forces a team of experts working together in integrated processes, from idea, to early and detailed design
- Implementing environmental costs in an already widely used tool- more likely that different environmental design will be part of decisions
- Increased decision support in the design process for the actors involved
- Hopefully: time savings, cost savings, reduced environmental load 😊

**Thank you for your attention!**

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